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Atty. Dkt. No. 200209179-1

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

- 1 1. (Previously Presented) A method of determining a placement of services of a distributed application onto nodes of a distributed resource infrastructure comprising the steps of:
 - 4 forming communication constraints between node pairs which ensure that a sum of transport demands between a particular node pair does not exceed a transport capacity between the particular node pair, each term of the sum comprising a product of a first placement variable, a second placement variable, and the transport demand between the services associated with the first and second placement variables;
 - 10 forming an objective; and
 - 11 employing a local search solution to solve an integer program comprising the communication constraints and the objective, which determines the placement of the services onto the nodes.
- 1 2. (Previously Presented) A method of determining a placement of services of a distributed application onto nodes of a distributed resource infrastructure comprising the steps of:
 - 4 establishing an application model of the services comprising transport demands between the services;
 - 6 establishing an infrastructure model of the nodes comprising transport capacities between the nodes;
 - 8 forming an integer program that comprises:
 - 9 a set of placement variables for a combination of the services and the nodes, each of the placement variables indicating whether a particular service is located on a particular node;
 - 10 communication constraints between node pairs which ensure that a sum of

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13 the transport demands between a particular node pair does not exceed the
14 transport capacity between the particular node pair, each term of the sum
15 comprising a product of a first placement variable, a second placement
16 variable, and the transport demand between the services associated with the
17 first and second placement variables; and

18 an objective; and

19 employing a local search solution to solve the integer program which
20 determines the placement of the services onto the nodes.

1 3. (Canceled)

1 4. (Original) The method of claim 2 wherein the objective comprises minimizing
2 communication traffic between the nodes.

1 5. (Original) The method of claim 2 wherein the application model further
2 comprises processing demands for the services.

1 6. (Original) The method of claim 5 wherein the infrastructure model further
2 comprises processing capacities for the nodes.

1 7. (Original) The method of claim 6 wherein the integer program further comprises
2 processing constraints which ensure that a sum of the processing demands for each of
3 the nodes does not exceed the processing capacity for the node.

1 8. (Original) The method of claim 7 wherein the objective comprises minimizing
2 communication traffic between the nodes and balancing the processing demands on
3 the nodes.

1 9. (Original) The method of claim 6 wherein the processing demands and the
2 processing capacities are normalized according to a processing criterion.

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1 10. (Original) The method of claim 9 wherein the processing criterion comprises an
2 algorithm speed.

1 11. (Original) The method of claim 9 wherein the processing criterion comprises a
2 transaction speed.

1 12. (Original) The method of claim 9 wherein the processing capacities of the nodes
2 are found according to a look-up table in which different types of nodes have been
3 normalized according to the processing criterion.

1 13. (Original) The method of claim 2 wherein the application model further
2 comprises storage demands for the services.

1 14. (Original) The method of claim 13 wherein the infrastructure model further
2 comprises storage capacities for the nodes.

1 15. (Original) The method of claim 14 wherein the integer program further
2 comprises storage constraints which ensure that a sum of the storage demands for
3 each of the nodes does not exceed the storage capacity for the node.

1 16. (Original) The method of claim 2 wherein the integer program further comprises
2 placement constraints which ensure that each of the services is placed on one and
3 only one of the nodes.

1 17. (Original) The method of claim 2 wherein the services reside on the nodes
2 according to a previous assignment.

1 18. (Original) The method of claim 17 further comprising the step of assessing
2 reassignment penalties for service placements that differs from the previous
3 assignment.

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1 19. (Original) The method of claim 18 wherein the integer program further
2 comprises a second objective that seeks to minimize the reassignment penalties.

1 20. (Previously Presented) A method of determining a placement of services of a
2 distributed application onto nodes of a distributed resource infrastructure comprising
3 the steps of:

4 establishing an application model of the services that comprises processing
5 demands for the services, storage demands for the services, and transport
6 demands between the services;

7 establishing an infrastructure model of the nodes that comprises processing
8 capacities for the nodes, storage capacities for the nodes, and transport capacities
9 between the nodes;

10 forming an integer program that comprises:

11 a set of placement variables for a combination of the services and the
12 nodes, each of the placement variables indicating whether a particular service
13 is located on a particular node;

14 processing constraints which ensure that a sum of the processing demands
15 for each of the nodes does not exceed the processing capacity for the node;

16 storage constraints which ensure that a sum of the storage demands for
17 each of the nodes does not exceed the storage capacity for the node;

18 placement constraints which ensure that each of the services is placed on
19 one and only one node;

20 communication constraints between node pairs which ensure that a sum of
21 the transport demands between a particular node pair does not exceed the
22 transport capacity between the particular node pair, each term of the sum
23 comprising a product of a first placement variable, a second placement
24 variable, and the transport demand between the services associated with the
25 first and second placement variables; and

26 an objective of minimizing communication traffic between the nodes and
27 balancing processing loads on the nodes; and
28 employing a local search solution to solve the integer program which

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29 determines the placement of the services onto the nodes.

1 21. (Previously Presented) A computer readable memory comprising computer code
2 for directing a computer to make a determination of a placement of services of a
3 distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps of:
5 forming communication constraints between node pairs which ensure that a
6 sum of transport demands between a particular node pair does not exceed a
7 transport capacity between the particular node pair, each term of the sum
8 comprising a product of a first placement variable, a second placement variable,
9 and the transport demand between the services associated with the first and
10 second placement variables;
11 forming an objective; and
12 employing a local search solution to solve an integer program comprising the
13 communication constraints and the objective, which determines the placement of
14 the services onto the nodes.

1 22. (Previously Presented) A computer readable memory comprising computer code
2 for directing a computer to make a determination of a placement of services of a
3 distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps of:
5 establishing an application model of the services comprising transport
6 demands between the services;
7 establishing an infrastructure model of the nodes comprising transport
8 capacities between the nodes;
9 forming an integer program that comprises:
10 a set of placement variables for a combination of the services and the
11 nodes, each of the placement variables indicating whether a particular service
12 is located on a particular node;
13 communication constraints between node pairs which ensure that a sum of
14 the transport demands between a particular node pair does not exceed the

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15 transport capacity between the particular node pair, each term of the sum
16 comprising a product of a first placement variable, a second placement
17 variable, and the transport demand between the services associated with the
18 first and second placement variables; and
19 an objective; and
20 employing a local search solution to solve the integer program which
21 determines the placement of the services onto the nodes.

1 23. (Canceled)

1 24. (Original) The computer readable memory of claim 22 wherein the objective
2 comprises minimizing communication traffic between the nodes.

1 25. (Original) The computer readable memory of claim 22 wherein the application
2 model further comprises processing demands for the services.

1 26. (Original) The computer readable memory of claim 25 wherein the infrastructure
2 model further comprises processing capacities for the nodes.

1 27. (Original) The computer readable memory of claim 26 wherein the integer
2 program further comprises processing constraints ensure that a sum of the processing
3 demands for each of the nodes does not exceed the processing capacity for the node.

1 28. (Original) The computer readable memory of claim 27 wherein the objective
2 comprises balancing the processing demands on the nodes.

1 29. (Original) The computer readable memory of claim 26 wherein the processing
2 demands and the processing capacities are normalized according to a processing
3 criterion.

1 30. (Original) The computer readable memory of claim 29 wherein the processing

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2 criterion comprises an algorithm speed.

1 31. (Previously Presented) The computer readable memory of claim 29 wherein the
2 processing criterion comprises a transaction speed.

1 32. (Previously Presented) The computer readable memory of claim 29 wherein the
2 processing capacities of the nodes are found according to a look-up table in which
3 different types of nodes have been normalized according to the processing criterion.

1 33. (Original) The computer readable memory of claim 22 wherein the application
2 model further comprises storage demands for the services.

1 34. (Original) The computer readable memory of claim 33 wherein the infrastructure
2 model further comprises storage capacities for the nodes.

1 35. (Original) The computer readable memory of claim 34 wherein the integer
2 program further comprises storage constraints which ensure that a sum of the storage
3 demands for each of the nodes does not exceed the storage capacity for the node.

1 36. (Original) The computer readable memory of claim 22 wherein the integer
2 program further comprises placement constraints which ensure that each of the
3 services is placed on one and only one of the nodes.

1 37. (Original) The computer readable memory of claim 22 wherein the services
2 reside on the nodes according to a previous assignment.

1 38. (Original) The computer readable memory of claim 37 further comprising the
2 step of assessing reassignment penalties for service placements that differs from the
3 previous assignment.

1 39. (Original) The computer readable memory of claim 38 wherein the integer

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2 program further comprises a second objective that seeks to minimize the
3 reassignment penalties.

1 40. (Previously Presented) A computer readable memory comprising computer code
2 for directing a computer to make a determination of a placement of services of a
3 distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps of:
5 establishing an application model of the services that comprises processing
6 demands for the services, storage demands for the services, and transport
7 demands between the services;
8 establishing an infrastructure model of the nodes that comprises processing
9 capacities for the nodes, storage capacities for the nodes, and transport capacities
10 between the nodes;
11 forming an integer program that comprises:
12 a set of placement variables for a combination of the services and the
13 nodes, each of the placement variables indicating whether a particular service
14 is located on a particular node;
15 processing constraints which ensure that a sum of the processing demands
16 for each of the nodes does not exceed the processing capacity for the node;
17 storage constraints which ensure that a sum of the storage demands for
18 each of the nodes does not exceed the storage capacity for the node;
19 placement constraints which ensure that each of the services is placed on
20 one and only one node;
21 communication constraints between node pairs which ensure that a sum of
22 the transport demands between a particular node pair does not exceed the
23 transport capacity between the particular node pair, each term of the sum
24 comprising a product of a first placement variable, a second placement
25 variable, and the transport demand between the services associated with the
26 first and second placement variables; and
27 an objective of minimizing communication traffic between the nodes and
28 balancing processing loads on the nodes; and

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29 employing a local search solution to solve the integer program which
30 determines the placement of the services onto the nodes.